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Examination of Fouling Mechanism on Ion-Exchange Membranes and Development of Ion-Exchange Membranes with High Anti-Fouling Properties

Mitsuru Higa [1], Kenji Hori [1], Akio Kamimura [2] and Nobutaka Endo [1]

[1] Applied Fine Chemistry, Graduate School of Science and Engineering, Yamaguchi University
[2] Applied Medical Engineering Science, Graduate School of Medicine, Yamaguchi University

Summary

Fouling of an ion-exchange membrane is one of the most serious problems in their application to many industrial fields such as water treatment, food industry, medical supplies and waste water treatment. In case that electrodialysis consisting of an ion-exchange membrane and aqueous solutions of salts containing organic substances, particularly macromolecules, organic fouling of the membrane occurs and deteriorates a performance of the membrane.

In this study, organic fouling behavior of commercially available anion-exchange membranes, AMX, ASM and ASM-F was examined in an electrodialysis system consisting of one of the membranes and NaCl solutions containing sodium dodecylbenzene-sulfonate (DBS) solution as an organic foulant. During electrodialysis at a current density of 10 mA/cm^2, a change of voltage between the membrane surfaces was measured by using platinum wire electrodes fixed near to both surfaces of the membrane, changing temperature of the system. The increase in the voltage between the probe electrodes means that the organic fouling occurs during the electrodialysis. After the electrodialysis, the concentration of DBS in the solution of anode chamber was determined with an ultraviolet detector. Permeability coefficient of the foulant for each membrane was calculated from the time-concentration curves of the foulant.

The slope of the time-voltage curves through ASM decreases with increasing temperature. This means the organic fouling was suppressed when temperature increase. The change in the time-voltage curves through ASM-F is lowest in all the membranes. The permeability coefficient of DBS through all the membranes increases with increasing temperature because of the increase in the water content of the membranes. ASM-F has lower permeability coefficient of DBS than ASM at all the temperatures. This means that ASM-F has higher barrier property against DBS than ASM. ASM-F has the highest anti-organic fouling property in all the membranes because of its loose network structure and thin charged layers on the membrane surfaces with the same in sign as the charged group of DBS.